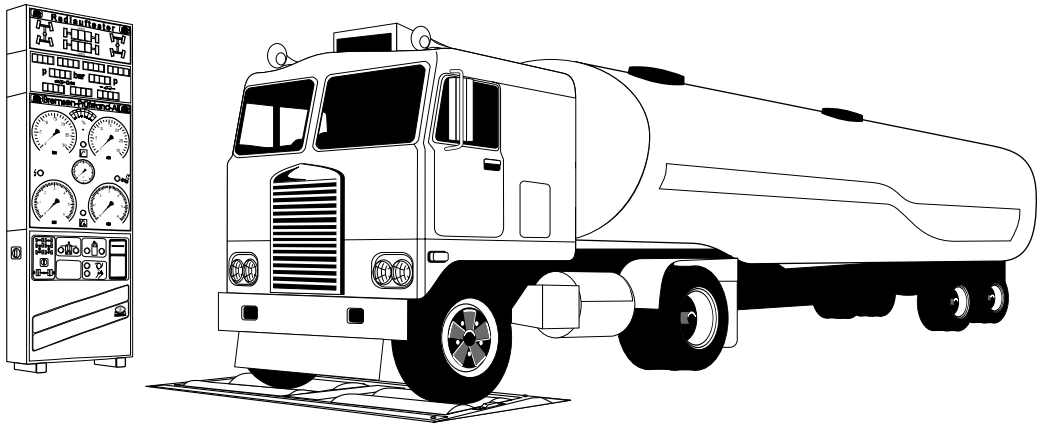
IW4 WB / WBV
IW7 WB / WBV

Roller Brake Tester

for vans and trucks up to 13t / 18t axle load



Standard Operating Procedures and User's Manual

English

D1 0412BA1-GB04

EDITION

Version 4 of the operations manual dated 2005-08-08
D1 0412BA1 GB04
Software Version 1.43
Software Version 1.44 / MB
Software Version 1.45 / Portugal
Software Version 1.46 / Deutschland
Software Version 1.48 / Hongkong

© MAHA GMBH & CO. KG.

All rights reserved. Any reproductions of this document, partial or complete, are only allowed with prior consent of MAHA GmbH & Co. KG.

All rights reserved in cases of patent granting or registration of design.

The contents of this version have been checked with great care. However, errors cannot be fully excluded. Please contact MAHA should you find errors of any kind.
Subject to technical change without notice.

These instructions are intended for users with previous technical knowledge in the field of vehicle testing technology as well as basic computer knowledge and MS-Windows operating system application.

Windows and Windows for Workgroups is a registered trademark of the Microsoft-Corporation.

MANUFACTURER

MAHA Maschinenbau Haldenwang GmbH & Co. KG.
Hoyen 20
D-87490 Haldenwang/Allgäu

Telephone: 08374 / 585-0
Telefax: 08374/ 585-499

Internet: http://www.maha.de
e-mail: maha@maha.de

SERVICE

MAHA Maschinenbau Haldenwang GmbH & Co. KG.
- Service dept. -
Hoyen 20
D-87490 Haldenwang/Allgäu

Hotline: 0180 56242 + extension
60 for brake testers, test lanes
80 for lifting technology
90 for performance testers, exhaust and air conditioning service equipment

Service: 0180 5624250
Telefax: 0180 5624255

TABLE OF CONTENTS

1 Description 1

1.1 Introduction 1
1.2 General Information about Brake Testing 1
1.2.1 Vehicle with a Driven Axle 2
1.2.2 4-Wheel Drive Vehicle 2
1.3 Technical Data 5
1.3.1 Electrical Data 5
1.3.2 Mechanical Data 6
1.3.3 Electronic 7
1.4 Standard Equipment IW4/IW7 WB/WBV (4WD) 7
1.5 Noise Emission 7
1.6 Equipment IW7 MB Version 8

2 Safety 9

2.1 Introduction 9
2.2 Safety Regulations for Commissioning 10
2.3 Safety Regulations during Operation 10
2.4 Safety Regulations for Service Work 10
2.5 Attention 11
2.6 Further Information 11
2.7 Combination with Accessories 11
2.8 Exchange of Parts 11
2.9 Safety Features 12
2.9.1 Lockable Main Switch 12
2.9.2 Sensor Rollers (Brake Tester) 12
2.9.3 Pit Safety (Option) 12
2.9.4 Warning and Information Labels 12

3 Operations 13

3.1 Symbol Description 13
3.2 IW7 Equipment Variations 16
3.3 IW4 Equipment Variations 19
3.4 Preparations for a Brake Test 22
3.5 Running a Brake Test 22
3.5.1 Determining the Roller Resistance 23
3.5.2 Ovality Test (optional) 23
3.5.3 Maximum Brake Force Test 24
3.6 Imbalance Display (Optional) 25
3.7 Special Features on Test Stands with MB Mode 25
3.8 Special Points about the Portugal-Mode 26
3.9 Special Points about the Sweden Mode 26
3.10 Special Points about the Hongkong Mode 27

4 Maintenance, Error Codes 29

4.1 Maintenance of the Roller Set 29
4.2 Description of Error Codes 30
4.3 General Error Codes 30
4.4 Additional Defect Codes on 4-Wheel Drive Test Stands 32
4.5 Installation and Dismantling of the Test Stand 32

1 Description

1.1 Introduction

The IW4/IW7 WB/WBV (4WD) belong to the group of roller brake testers.
This class includes two different measuring methods to record brake forces:

- the testing of drive torque or
- the testing of drive power.

The former is applied in the MAHA IW4/IW7 WB/WBV (4WD) brake tester. The IW4/IW7 WB/WBV (4WD) consists of a proven roller set and an open-ended electronic system based on a processor board with an integral operating system.

The standard test stand may be expanded to a complete test line by using the MAHA accessories.

1.2 General Information about Brake Testing

To avoid skidding it is important that the brake forces of the individual wheels of one axle are the same. Just as important is the minimum brake torque for each individual wheel, so that when braking no vehicle brake is overburdened. Consequently, each wheel is tested individually on the brake tester.

For measuring the brake force, a static and a dynamic method are available. Using the static method the force necessary to rotate a wheel which is positioned on a plate, with applied brakes is determined. The dynamic method is more practice orientated - whereby the wheel is brought up to a predetermined RPM by the motor driven roller set and then the brakes are applied. A sensor roller measures the wheel revolutions. A comparison of the drive roller RPM to the sensor roller RPM determines how large the slippage is. For safety reasons, all MAHA brake testers automatically interrupt the brake test at a slippage of approximately 30%.

The measurement principle is the same for both methods of testing. The drive motor is supported in a rotary fashion (motor housing not supported); without any additional support, the drive shaft and the housing would counter rotate when under load, depending on the force distribution. The additional support consists of a flexible beam, on which the housing rests. The steel beam bends corresponding to the torque produced by the motor, which the beam resists. The torque is zero at the beginning of the static test. With the dynamic test method, the torque is just high enough to set the drive rollers with the vehicle wheel in motion with the brakes not applied.

A strain gauge is mounted on the transverse beam which converts the brake force into a usable electrical value.

For the IW4/IW7 WB/WBV (4WD)) brake tester the dynamic test method is used. This method ensures the most accurate measurement. There is simply no alternative for 4 wheel drive brake testing.

1.2.1 Vehicle with a Driven Axle

Drive the wheel axle to be tested onto the roller set. This will push both sensors rollers down which measure the RPM of the wheels. Now both drive motors of the roller set will slowly accelerated to nominal speed turning both vehicle wheels forward. When the drive motors have reached nominal speed a comparison is made between the nominal drive roller speed and the sensor roller speed in order to be able, at any time, to switch off the drive motors when a slippage of 30% is exceeded. (This is to protect the drive motors against overload and the tires against excessive wear.)

The READY indicator will light up, signaling that the test rig is ready to start the brake test. During brake tests the vehicle is decelerated to a point, that at least one sensor roller exceeds 30% slippage and the drive motors are switched off.

1.2.2 4-Wheel Drive Vehicle

On non-permanent 4-wheel drive vehicles the brakes are tested with the 4-wheel drive switched off, just like vehicles with only one drive axle.

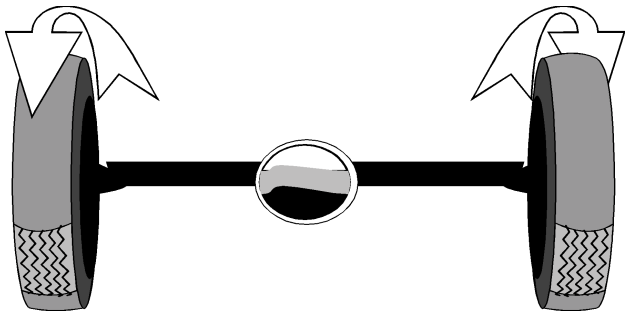
Principle of 4 Wheel Drive

On 4-wheel drive vehicles the torque applied to the drive shaft is evenly distributed to all four wheels, i.e. a quarter of the total torque will be applied to each wheel. The same applies for the brake torques that arise when braking. When testing 4 wheel drive vehicles it must therefore be ensured that no brake torque will be transferred from one vehicle wheel to the other. This is accomplished if no torque is applied to the drive shaft of the differential during the brake test.

The following example will explain this in detail:

In order to simulate a defective brake, one brake is disabled. Now only one brake of the axle to be tested is enabled. If the brake test is done on a standard test stand where the torque is not eliminated from the drive shaft, the same force applies to the strain gauges of both drive motors, i.e. the same brake torque will be indicated. This would lead to the false assumption that the brakes are fully intact. If the test was conducted correctly, no brake torque would be indicated for the wheel with the disabled brake and the actual brake torque applied to the other wheel would appear.

If both wheels of the axle to be tested are rotating forward during the brake test, the vehicle will be lifted out of the test rig, as torque is transferred by the drive shaft to the wheels of the other vehicle axle. To prevent this, the wheels counter rotate with the same RPM, one vehicle wheel is driven in forward direction and the other wheel in reverse direction. This eliminates the torque built-up in the differential against the drive shaft and transmission of torque to the other vehicle axle.



As the brake characteristics depend on the rotating direction of the wheels (the brake linings and brake drums are ground in forward direction), only the brake torque of the wheel rotating in forward direction is measured. For this reason, the brake test has to be done separately for each wheel.

In order to obtain a reliable comparision between the brake forces of both wheels of the same axle, the same pedal force will have to be applied at the brake test of the left and right wheel. To accomplish this, a pedal force meter can be connected to the vehicle's brake pedal.

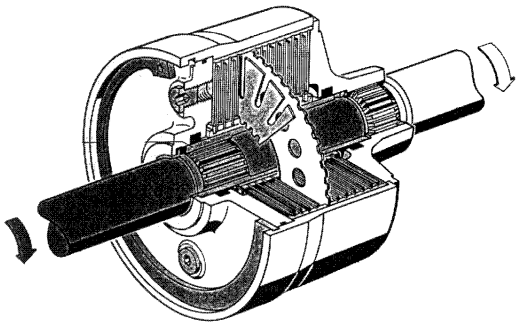
It is also possible to measure the current pressure Pm of the hydraulic brake by means of a pressure sensor.

Testing of various 4-wheel drive types

There are three different types of 4-wheel drives:
a) Disengageable drive shaft leading to the differential
b) Visco-clutch (VC) in the drive shaft leading to the differential
c) Rigid drive shaft between the differentials

a) Disengageable drive shaft leading to the differential
On vehicles equipped with non-permanent 4-wheel drive, the brakes are tested with the 4-wheel drive switched off, just like vehicles with only one drive axle.

b) Visco-clutch (VC) in the drive shaft leading to the differential
There are two different Visco-clutch types. The soft Visco clutch has a higher torsibility (viscosity) than the hard Visco clutch, therefore no torque is transferred to the other wheels when the drive shaft rotation is low.



As described above, brake tests on 4-wheel drive vehicles are feasible if both wheels on the same axle counter-rotate at the same speed. As, in practice, the circumference of the left and right wheel is not exactly the same due to different tire tread depths and uneven tire pressure, the RPM of the two drive motors is normally different. Therefore the drive motors must control their speed in order to obtain the same RPM for both wheels.

Approximately the same speed of the roller set drive motors will be sufficient for a 4-wheel drive vehicle having a soft VISCO clutch in the drive shaft as no brake torque is transferred by the VISCO clutch when the drive shaft rotation is low. Therefore the speed control of the drive motors alone will be sufficient in this case.

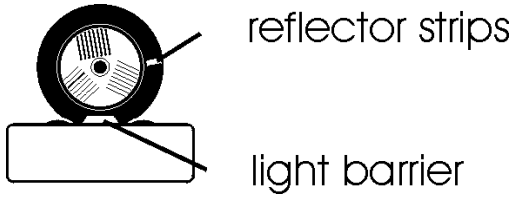
Contrary to the above, when testing the brakes of 4-wheel drive vehicle having a hard VISCO clutch in the drive shaft both wheels on the same axle must rotate synchronously during the brake test, as the clutch viscosity is so low that even the slowest rotation of the drive shaft will transfer brake torque to the other wheels through the VISCO clutch.

c) Rigid drive shaft between the differentials

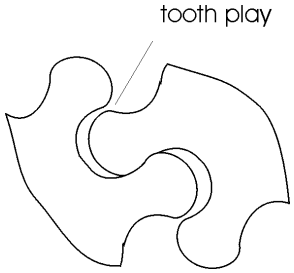
To perform a brake test on a 4-wheel drive vehicle having a rigid drive shaft, the wheel rotations must be exactly controlled in such a way that no brake torque can be transferred by the drive shaft.

Controlling the synchroneous rotation of the wheels

In order to control synchronous rotation of the wheels, reflector strips are fastened to the sides of the wheels which trigger a signal via two photo-electric cells, mounted on the side of the roller set.



On vehicles equipped with a rigid drive shaft or with a hard Visco clutch the wheels cannot be individually turned. If one vehicle wheel is turned forward in the roller set, the other wheel (on the same axle) will be turning backwards in a synchronous manner. If one wheel is turned slowly in forward or backward direction, one will note that the other wheel starts turning with a little delay. This slight delay in following the other wheel to turn is caused by the gear play (backslash of teeth) inside of the differential.



To perform a brake test on a 4-wheel drive vehicle having a rigid drive shaft, the wheel rotation must be controlled in such a way that no brake torque can be transferred by the drive shaft. This is achieved by staying within the gear play of the differential during the brake test. The differential will be in a "balance" state.

To be able to effectively use this, the exact backlash of teeth is assessed in a learning mode:

Initially the left drive motor will be switched on to accelerate the left vehicle wheel to nominal speed. As the right drive motor is switched off and thus running free, the left wheel is dragging the right wheel along. The flanks of a tooth in the differential touch each other on one side. Now the first limit position of gear play is measured by the reflector strips and the photo electric cells. The procedure is now reversed, the left drive motor of the roller set is switched off and the right vehicle wheel is accelerated to nominal speed. This time the left wheel is dragged along and in the differential the flanks of teeth touch each other on the opposite side. The second limit position of the gear play will now be measured. Out of the two measured limit positions the center of gear play is calculated. This "center of gear play" is used to control the rotation of wheels during the brake test.

During the brake test, both drive motors are accelerated to a speed where the "center of gear play" is reached. One vehicle wheel will rotate forward, the other in opposite direction. As soon as the nominal speed is reached by both wheels, and no brake torque is being transferred to the drive shaft, brake testing may be started.

As with standard vehicles the drive motors will be switched off if excessive slip occurs.

1.3 Technical Data

1.3.1 Electrical Data

	IW7 (4 wheel drive)	**IW4 (4 wheel drive)**
Voltage supply	400 V, 3 Phases, 50 Hz	400 V, 3 Phases, 50 Hz
Special voltage	230 V, 3 Phases, 50 Hz	230 V, 3 Phases, 50 Hz

Motor drive capacity

IW7/1	2 x 7,5 kW	IW4/1	2 x 7.5 kW
IW7/2	2 x 11 kW	IW4/2	2 x 9 kW
IW7/3	2 x 11 kW		
IW7/4	2 x 7,5 kW		

Star delta starters for motors with **IW7/1 E**, **IW7/2 E**, **IW4/1 E** and **IW4/2 E**
Dahlander-control system for **IW7/3 E** and **IW7/4 E**

Main switch fuse		**Main switch fuse with special voltage**	
IW7/1 and IW7/4	50 A slow	IW4 (4 wheel drive)	63 A slow
IW4/1	35 A slow	IW7 (4 wheel drive)	100 A slow
IW4/2	50 A slow		
IW7/2 and IW7/3	63 A slow		

Only trained electricians or authorized service technicians are allowed to carry out work on electrical parts of the brake tester. (Control box, roller set, etc.)

1.3.2 Mechanical Data

	IW7 (4 wd)	**IW4 (4 wd)**
Axle load (Standard) roller set, closed, self-supporting	max. 18 t	max. 13 t
Track (e.g. Roller set No. 2)	min.= 200 mm max.=track min.+2200 mm	min.= 200 mm max.=track min.+2200 mm
Roller diameter	265 mm	202 mm
Roller axle separation	475 mm	430 mm
Dimensions roller set	(HxWxL) 700x1142x1427 mm	(HxWxL) 500x1043x1225mm

Test speed

IW7/1	3 km/h	IW4/1	2.3 km/h
IW7/2	3 km/h	IW4/2	2.3 km/h
IW7/3	3 km/h and 6 km/h		
IW7/4	3 km/h and 6 km/h		

Roller friction coefficients

Steel	IW7 (4 wd)	IW4 (4 wd)	Plastic	IW7 (4 wd)	IW4 (4 wd)
Dry	ca. 0.9	ca. 0.9	dry	ca. 0.9	ca. 0.9
Wet	ca. 0.9	ca. 0.7	wet	ca. 0.9	ca. 0.9

Display range depending on model

	IW7 (4 wd)	IW4 (4 wd)
small measuring range	2 x 0-6 kN (optional 2 x 0-8 kN)	2 x 0-7,5 kN
large measuring range	2 x 0-30 kN (optional 2 x 0-40 kN)	2 x 0-30 kN
Diameter Analog display	350 mm	350 mm

Display accuracy	> 2%
Measuring accuracy	> 1%
Operating temperature	-10°C to +40°C
Double pressure pneumatic gauge Pressure gauge dial diameter	200 mm

1.3.3 Electronic

Processor PCB with operating system
EEPROM for variable system configuration

6 Slots for system expansion

Serial interface RS 232

Connection for LCD-Display

Subject to technical alterations without notice!

Only trained electricians or authorized service technicians are allowed to carry out work on electrical parts of the brake tester. (Control box, roller set, etc.)

1.4 Standard Equipment IW4/IW7 WB/WBV (4WD)

IW4 (4WD): Roller set no.1 or no.2

IW7 (4WD): Roller set no.2

Single wheel mode
Delayed automatic switch on
Automatic switch-off after exiting the roller set
Automatic slip switch-off including pointer stop and automatic re-start
Electronic strain gauge
Lockable main switch
RS 232 Interface
Optional:
Weighing system; static (2 pressure cells) or dynamic (4 pressure cells)

Standard equipment subject to change without notice.

Standard equipment of the current price list apply.

In addition to the standard versions, Maschinenbau Haldenwang (MAHA) offers various expansion possibilities which are listed in the current price list.

1.5 Noise Emission

The noise emission value created when the tester is in operation is less than 70dB(A) in the work area of the operational personnel.

1.6 Equipment IW7 MB Version

- The roller brake testers equippped with the Mercedes-Benz-Program differ in several aspects from the standard version:
- Sticker indicating MB-recognition and month and year of production
- Optical acknowledgement of the slip shut-off via 2 lamps below the display instruments
- Manual- and automatic operation
- Remote control
- Key switch / Emergency-Off switch on the front side of the display panel (optionally available for inspection pit)
- Counter for hours of operation
- Calibration possibilities using push button in control cabinet while drive motors running
- Possible to install roller set using MAHA-adapter set in MB-standard pit
- Running rollers made of grooved steel with sanding or synthetic coating
- Additional malfunction-release button with integrated malfunction lamp

2 Safety

2.1 Introduction

Before commissioning the machinery please read the operating instructions carefully and thoroughly and comply with the instructions. The instruction manual should always be conveniently stored to be readily accessible at all times.

Injury to persons incurred due to non-compliance with these operating instructions is not covered by the product liability laws.

MAHA will not accept and is not liable for any claims for damage to the test stand and/or vehicle or service costs incurred due to non-compliance with these operating instructions.

Warning means that instructions that are not complied with or incompletely complied with can endanger persons.

Attention means that instructions that are not complied with or incompletely complied with can lead to equipment damage.

Notes provide additional information.

Safety information is provided to warn about dangerous situations and help prevent damage to equipment and injury to persons. For your own safety it is imperative that all safety regulations included in these instruction be carefully observed.

Carefully observe all national and international safety and health regulations. Every user is responsible for observing all regulations which apply to his workplace and is obliged to integrate any new regulations that may be initiated.

2.2 Safety Regulations for Commissioning

- The test stand may only be commissioned by MAHA service technicians or those authorized by MAHA as service partners.
- All electrical parts of the testing machinery must be protected from moisture and humidity.
- The test stand may not be installed or operated in exlpsion endangered rooms or wash halls.

2.3 Safety Regulations during Operation

- The MAHA test stand may only be used and operated for its intended purpose and within its stated performance limits.
- The MAHA test stand may only be operated by trained, authorized personnel. The test lane and the surrounding work area must be kept clean.
- The test stand must be switched off when not in use and the main switch secured against tampering with a padlock.
- No persons are allowed in the MAHA test stand danger zone. Rotating or moving parts are dangerous. (e.g. test stand rollers)
- In case of emergency turn the main switch (the Emergency-Off switch) to 0.
- Running vehicle engines represent potential carbon monoxide poisoning. The operator/owner is responsible for providing sufficient air ventilation.

2.4 Safety Regulations for Service Work

- Service work such as installation, maintenance or repair work on the MAHA test lane Eurosystem may only be done by MAHA service technicians or authorized service partner technicians.
- All work done on electrical parts of the equipment is to be carried out by trained, qualified electricians.
- Before doing any repair / maintenance / set up work turn off the main switch and secure it against tampering.

2.5 Attention

- When the vehicle is on the brake tester roller set with the driven axle, exit the roller set only when the roller drive is running. Exiting when the roller drive is not on can destroy the electric motors due to extreme acceleration of the rollers.
- The brake tester may not be operated without a functioning slip monitoring. Otherwise there is risk of tire damage.
- Never start a vehicle engine using the roller set drive. This can lead to equipment damage.
- No vehicle with a rigid 4-wheel drive may be tested on the brake tester with a standard roller set. This can lead to damage to both vehicle and test lane. Please ask your MAHA service representative for more information.

2.6 Further Information

- 4 wheel drive vehicles cannot be tested using the standard roller set. Erroneous tests will be the result.
  A special 4 wheel drive control is necessary. Please ask your MAHA service representative for more information.
- Avoid unnecessary strain on vehicle and test stand.
  Drive the vehicle slowly onto the test stand.
  Pay attention that the vehicle has sufficient ground clearance.

2.7 Combination with Accessories

The test stand may only be operated with accessories which MAHA has provided or approved. This applies especially for every accessory with electrical and/or mechanical connections to the MAHA test stand.

2.8 Exchange of Parts

Only genuine MAHA spare parts may be used to guarantee reliable functioning and thereby the safety of the MAHA test stand. Original MAHA spare parts are manufactured under the highest quality standards.

2.9 Safety Features

The safety features are to be inspected regularly by an authorized service technician. (recommended interval: 12 months). Official guidelines should be followed at all times.

The test stand may not be operated when the safety features are defective.

2.9.1 Lockable Main Switch

Serves as normal On and Off switch for the test stand as well as an EMER OFF switch.

The switch can be secured against unauthorized switch on by using a padlock.

2.9.2 Sensor Rollers (Brake Tester)

Both sensor rollers must be pressed to start the roller brake tester.

The RPM difference between sensor rollers and test stand roller determines the slip. If the preset slip is reached the roller drive switches off.

2.9.3 Pit Safety (Option)

Light barrier or infrared movement sensor. Prevents the test stand from starting up when persons are in the pit.

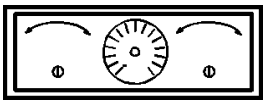
2.9.4 Warning and Information Labels

Warning and information labels are attached to the MAHA test stand. The labels may not be changed or removed. Unreadable labels must be replaced.

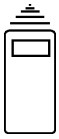
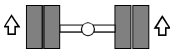
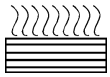
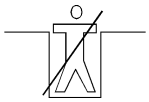
3 Operations

3.1 Symbol Description

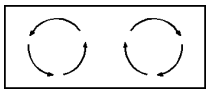
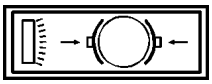
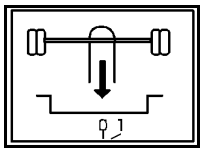
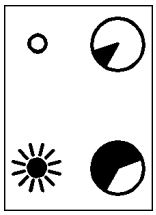
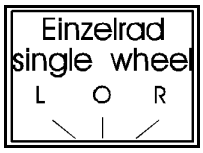
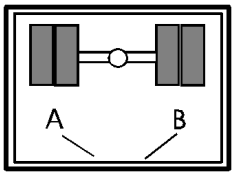
These symbols describe the signal lamps and operational elements which are located on the front of the test stand. Various switches are optional and may not be available.

Symbol	Description
	Ready When this lamp is lit, the brake pedal may be operated (and/or Hand brake) .
	Power ON When this lamp is lit the test stand is ready for operation.
	Automatic/Malfunction Standard test stand: The red malfunction lamp is located on the left of this symbol. To the right is the Power-On button. Test stand with MB-Mode: The green lamp indicates that the test rig is in automatic operation.
	**Zero point-Potentiometer** Using the zero-point potentiometer on the right hand side of the test rig the pointers on the analog-display can be adjusted. In order to do this, the Power-On button must be pressed while the potentiometer is being turned.

Optional (Various switches are optional and are not necessarily available)

Symbol	Explanation
	**Remote Control** If using the RCF 30 this lamp is lit to indicate that there is contact with the pressure converters. If using the Tele-BPS II, a lit lamp indicates that contact has been established with the remote control. A blinking lamp indicates that a pressed button on the remote control has been confirmed.
	**Driving Direction Display** (Only with 4 wd test stands) The lit up arrow indicates which wheel is turning in driving direction.
	**Roller Heating** When the rotary switch is turned to the right -> Roller heating is ON. The switch is lit up green.
	**Pit Safety Device** *Red lamp is lit up continually:* The pit safety device has been triggered and the test stand has been completely switched off. Investigate the reason for the pit safety activation and correct the problem before the test stand is put into operation again. To restore operation the green button must be pushed. *Red lamp is blinking:* The pit safety system - model GSL - is defective. The blinking of the lamp with pit safety system GSL means that once the malfunction has been corrected, the pit safety must be reinstated.
	Graphic This lamp will light up after pressing the Graphic button on the remote control. Within 12 seconds after test begin the graphic drawing will take place
	Brake Force Application Limiter (optionally available Lights up when the brakes have been applied too quickly.
	Malfunction Lamp and Release Button (MB-Mode) The red defect lamp lights up when a malfunction occurs. (Error code via pointer, s. Chap. 4). To confirm press the release button.
	Manual (MB-Mode) When this lamp is lit the test stand is in manual mode.

Optional (various switches are optional and not necessarily available)

Symbol	Description
	**Driving Direction Reverse** Use the reversing switch to reverse the driving direction of the rollers. It is possible then to drive onto the test stand from 2 directions.
	Speed Switch-Over The testing speed of the rollers can be switched over from 3 km/h to 6 km/h. (only possible with IW7E /3, or IW7E /4).
	**Slip Switch-Off Control (MB-Mode)** The green lamp on the display lights up on the side on which the slip occurs first
	**'Unoccupied'-Simulation for Weight Simulator** When the rotary switch is set to **position 1** the test stand is in " inactive" mode to facilitate safe operation of the weight simulator. Turn the rotary switch to **0** to re-activate the test stand.
	**Manual Measurement Range Switch-Over** The large measurement range is always activated when the motors are turned on on test stands not equipped with load cell or remote control. For safety reasons, however, the smaller passenger car slip switch-off value has been selected as a pre-setting. The switch-over to the higher truck slippage value only takes place when the brake force exceeds 5 kN. If the test should be conducted using the truck slip value even with small brake values, use this button to switch directly over to the truck slip value. When a passenger car is driven onto the test rollers the small measurement range can be selected using this switch.
	**Single Wheel Switch** A selector switch has been installed for single wheel tests for test stands without remote control. Position 0: both rollers start up Position L: only the left-hand roller starts up Position R: only the right-hand roller starts up **If the selector switch is set to 0 after the single wheel measurement is completed the rollers will start up automatically when occupied!**
	**Weight Transfer Switch (Portugal-Mode)** A selection switch is built into test lanes with shock absorber testers for the weight measurement. Position A: Weight of the axle (for TRK) is measured via the brake tester (internal scale). Position B: Weight of the axle (for CARS) is measured via the shock absorber tester (external scale) and transferred to the brake tester.

3.2 IW7 Equipment Variations

The following pages offer diagrams of the different equipment variations available for the IW7. The suggestions are in no way binding and can vary. See the current price list for available equpiment accessories.

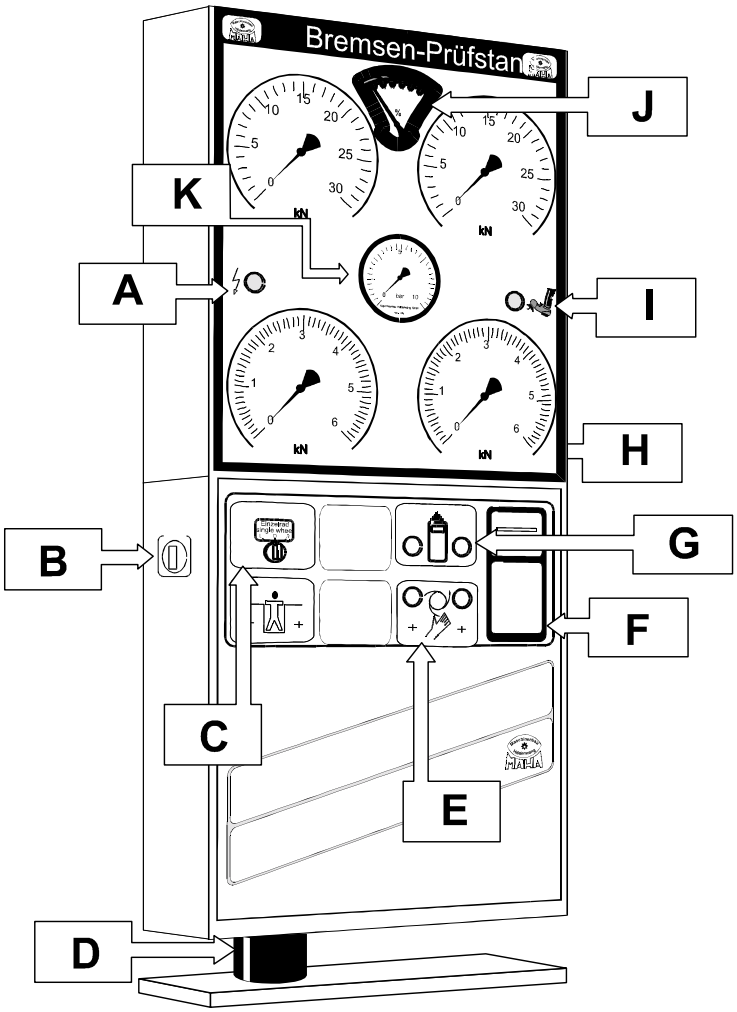


Fig. 3-1: IW7 (4 wd) Standard equipment iwth optional accessories

A	POWER-ON lamp
B	Main switch
C	Single wheel switch
D	Adjustment screw rotary foot
E	"Malfunction" lamp; "Mains-On" button
F	Data printer "PRINTCOM" (optional)
G	Control-Lamp "Remote control"
H	Zero-point potentiometer
I	"Ready" lamp
J	Differential display (optional)
K	Manometer pressure gauge

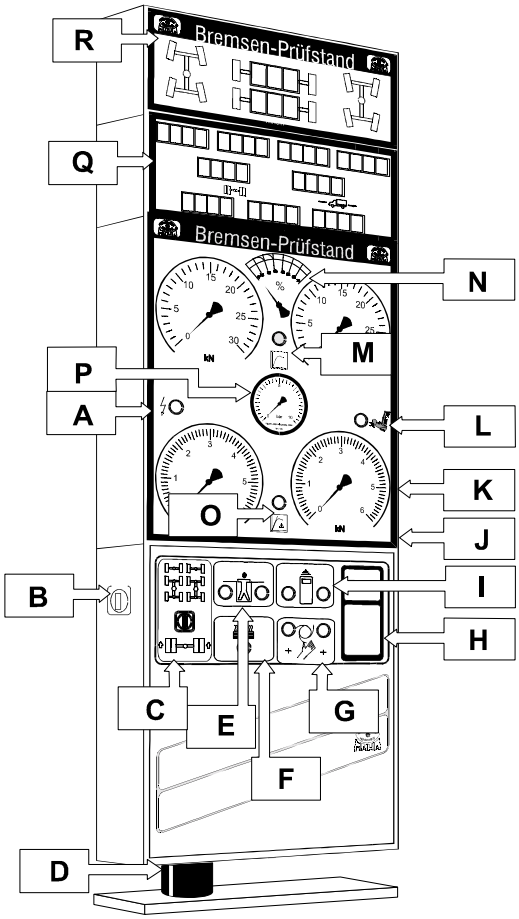


Fig: IW7 4-wheel drive version with optional accessories, side slip tester display and operator guidance

A	POWER-ON lamp
B	Main switch
C	4WD switch driving direction display (optional)
D	Adjustment screw rotary foot
E	Pit security (optional)
F	Roller heating (optional)
G	"Malfunction" lamp; "Mains-On" button
H	Data printer "PRINTCOM" (optional)
I	Control-Lamp "Remote control"
J	Zero-point potentiometer
K	Data printer "MINC" (optional)
L	"Ready" lamp
M	"Graphic" lamp (optional)
N	Differential display (optional)
O	"Application limiter" lamp (optional)
P	Manometer pressure gauge
Q	"Operator guidance" LED or LCD (optional)
R	Minc side-slip tester display (optional)

The display console can be ordered either with LED or LCD display for operator guidance, pressure display, wheel weights and deceleration.

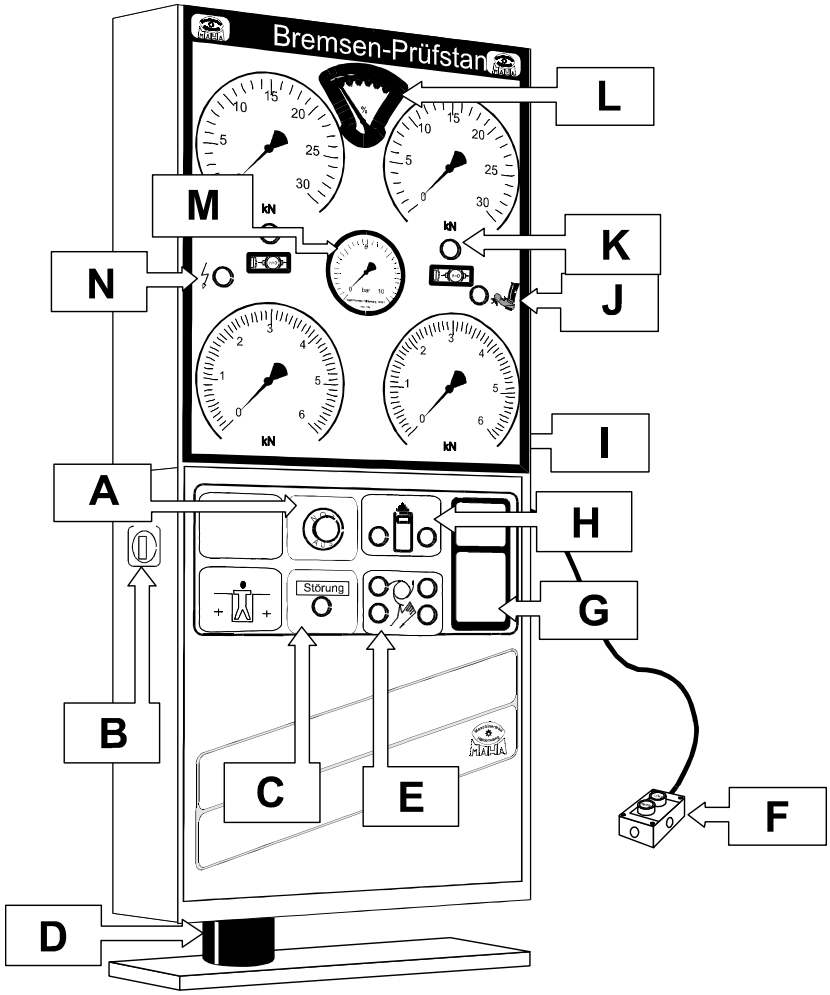


Fig. 3-3: IW7 (4 wd) Mercedes Benz-version

A	EMERGENCY-OFF switch
B	Main switch
C	"Malfunction" lamp; "Unlock" button
D	Adjustment screw rotary foot
E	"Automatic" button; "Manual" button
F	Cable remote control single-wheel mode
G	Data printer "PRINTCOM" (optional)
H	Control-Lamp "Remote control"
I	Zero-point potentiometer
J	"Ready" lamp
K	Slip switch-off right/left control lamps
L	Differential display (optional)
M	Manometer pressure gauge
N	POWER-ON lamp

3.3 IW4 Equipment Variations

The following pages offer diagrams of the different equipment variations available for the IW4 The suggestions are in no way binding and can vary. See the current price list for available equipment accessories.

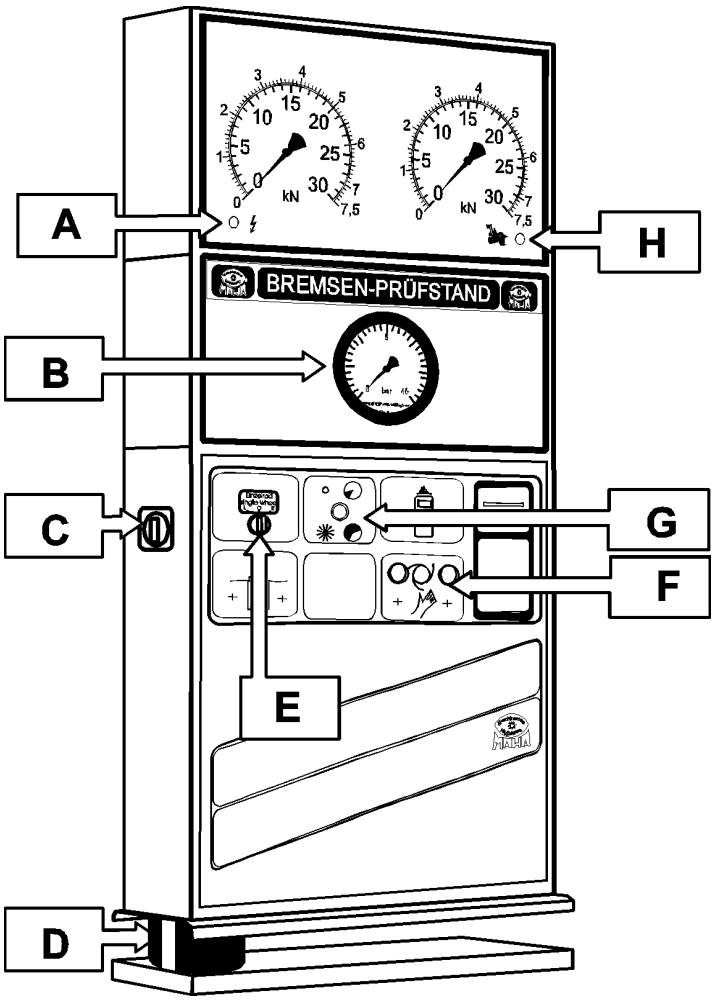


Fig. 3-4: IW4 expansion step 1

A	POWER-ON lamp
B	Manometer pressure gauge
C	Main switch
D	Adjustment screw rotary foot
E	Single-wheel switch
F	"Malfunction" lamp; "Power-On" button
G	Measuring range switch-over
H	READY display

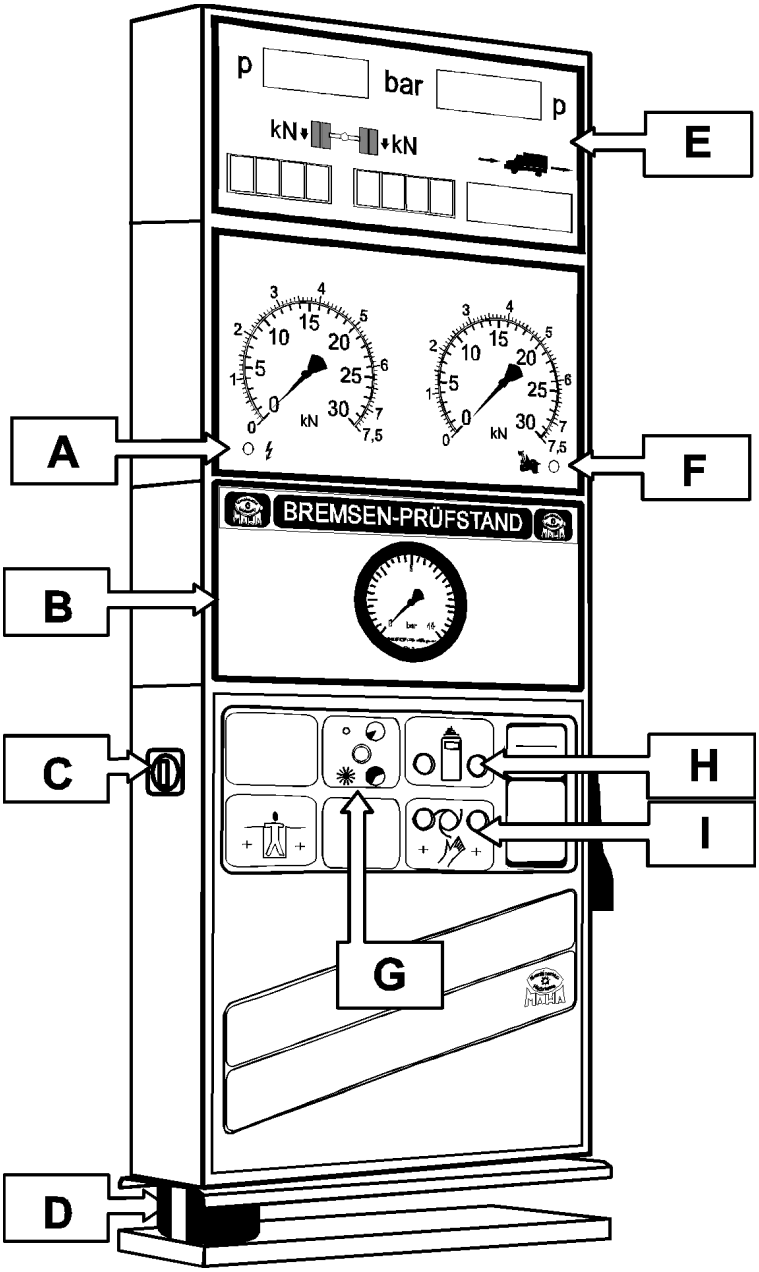


Fig. 3-5: IW4 expansion level 2

A	POWER-ON indication
B	Double pressure manometer and digital weight display of the wheel weight
C	Main switch
D	Adjustment screw rotary foot
E	Operator guidance display
F	READY display
G	Measuring range switch-over
H	"Remote control" lamp
I	MALFUNCTION lamp, POWER-ON lamp

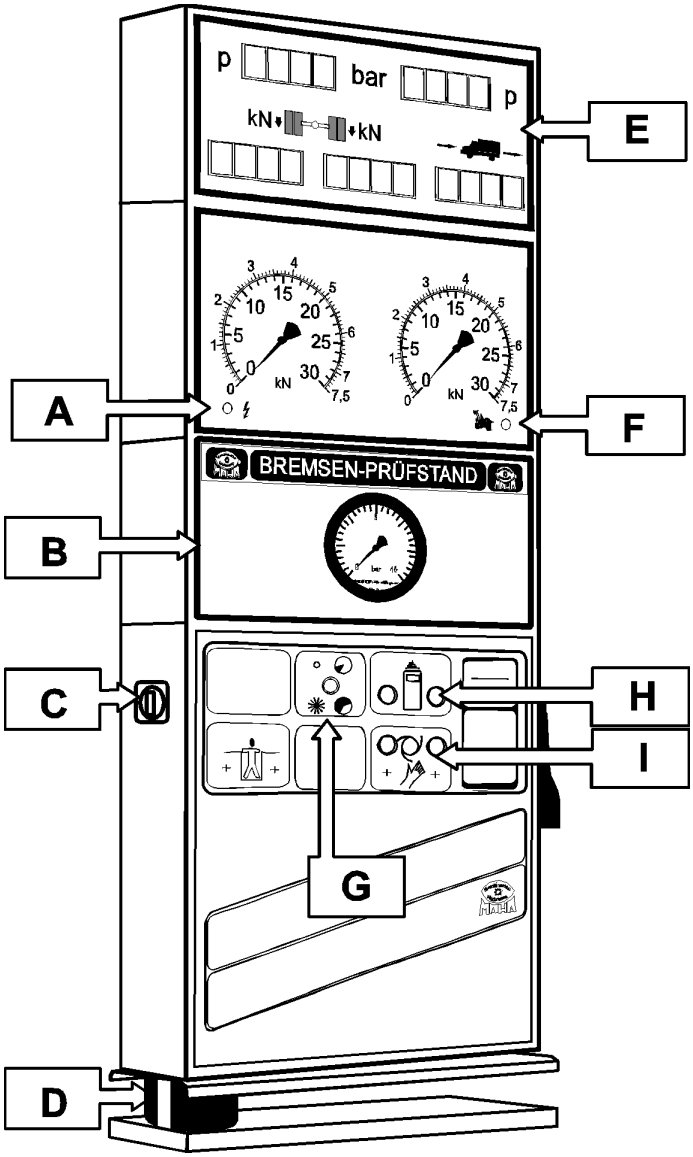


Fig. 3-6: IW4 expansion level 3

A	POWER-ON lamp
B	Double pressure manometer and digital weight display of the wheel weight
C	Main switch
D	Adjustment screw rotary foot
E	Operator guidance display
F	READY display
G	Measuring range switch-over
H	"Remote control" lamp
I	MALFUNCTION lamp, POWER-ON lamp

3.4 Preparations for a Brake Test

The procedures described here are for normal operation of 4 wheel drive test stands. (4 wheel drive switch to position "0"). **There is a seperate description available for the 4 wheel drive test.** (See Tele-BPS II + RCF 30 operating manual).

If the test stand is equipped with an internal scale no weight may burden the roller set when the test stand is switched on. Otherwise the weighing electronic will store this switch on weight as an Offset value and the measurement will be distorted.

- Enable main switch
  The needle of the display will complete an offset balance and return to zero.
- Press POWER ON key
  Press POWER ON button or the '*' key on the remote control.
  The white POWER ON lamp should now be lit up. The needles will again adjust and return to zero. The test stand is now ready for operation!!

On test stands without a PC-console but equipped with a DIN A4-printer which is offline or defective, the message "Printer defective (ONLINE?)" will appear after switch-on. If the test should be carried out without the printer, the printer can be de-activated by pressing the Power On button again.

- Select the measuring range (optional)
  If the test stand is equipped with a manual measurement range button, use it to select the desired measurement range. The integrated green lamp will light up when the large measurement range is selected.
- Conduct a single-wheel test (optional)
  Test stand which are not equipped with a remote control have a single wheel switch which facilitates single wheel testing. Depending on the test stand version the Power-On key must be pressed after a single wheel test.

The rollers will start up automatically after a single wheel test when the switch has been re-set to the 0 position.

3.5 Running a Brake Test

The manufacturer does not accept any liability claims for damage to low lying vehicle parts.

Drive first axle to be tested onto the roller set switch into idle. After the delayed start-up, the motors will be started individually. Should the motors switch off again immediately, the start-up monitor has been triggered to protect your vehicle and/or its tires against damage. One or both wheels may be jammed (seized bearings, jammed brake pads, etc.).

3.5.1 Determining the Roller Resistance

Before the brake pedal is applied, check needles for roller resistance. The roller resistance can have various values depending on vehicle type and load:

Car ca. 0,1 bis 0,6 kN
Truck ca. 0,5 bis 4,0 kN

The left-hand roller resistance should be approximately the same as the right-hand resistance. If large differences exist, a bearing might be faulty or a brake be jammed.

If the roller resistance of one or both wheels is so excessive that tire damage by the rollers may be anticipated or if the brake pedal has already been depressed, the **start-up monitor** will be triggered when the wheel is started, immediately switching the test stand off.

3.5.2 Ovality Test (optional)

The ovality test serves to determine the quality of the brakes. "Ovality" defines faulty concentric running of a wheel, e.g. out of round due to brake drum or disk brake deformation.

After the motors have started, wait until the yellow READY lamp lights up. The brake test can now be started.

- **Apply moderate force to the brake pedal**
  Apply moderate force to the brake pedal - approx. half of the max. brake force (switch-off value) and maintain brake force constant for at least one wheel revolution. The needles in the display will show the ovality value. The difference between the maximum and minimum display value of the needle is ovality in kN.

  - Press Ovality key
    If a remote control is being used for testing, the ovality key must remain pressed for one entire wheel revolution. The ovality is automatically stored with the brake values.

Ovality Measurement

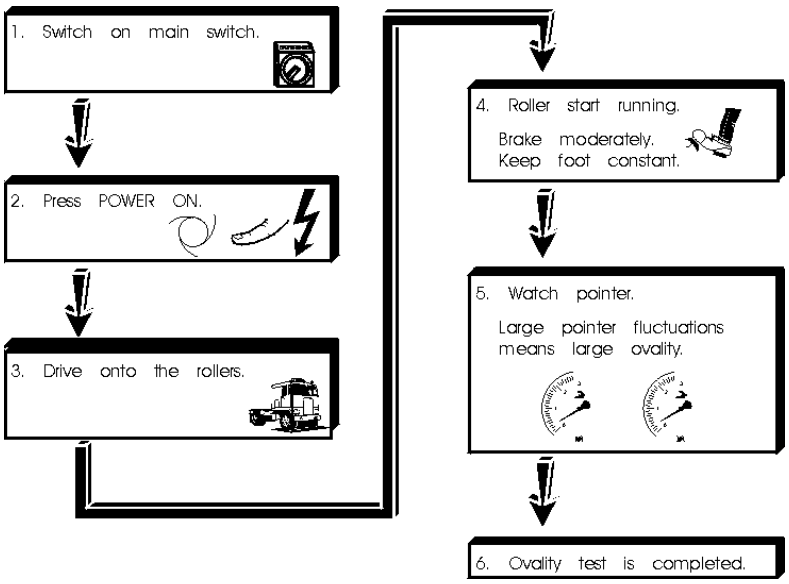


Fig. 3-7: The ovality measurement

The ovality value should not exceed 20% of the constant brake force. This value only represents a suggested guideline and is not based on any legal regulation.

3.5.3 Maximum Brake Force Test

On test stands with brake force application limiter (optional), the motors switch off automatically if the brake pedal was depressed too fast, and/or the **brake force application limiter** warning lamp lights up. In this case the vehicle must be braked until the wheels block or, if this is not possible, the vehicle must exit the roller set. Once the **Ready-lamp** lights up after the roller set is re-occupied the **brake force application limiter warning lamp** will extinguish. Now the test can be repeated. Make sure that braking is done slowly and constantly.

- Depress brake pedal completely.
  Depress brake pedal slowly and evenly.
- Observe the instruments on the display panel
  Observe the pointer instruments on the display cabinet. The pointers of the brake forces should move forward corresponding to the applied pedal force.
- Terminate the measurement
  As soon as one wheel has reached a slip of 30%, both rollers will be switched off. Now the maximum brake force has been reached. This value will be displayed by the needles until the motors are restarted (needle stop). Should the motor not switch off inspite of maximum pedal force, the brake force reached at maximum pedal force is the maximum brake force.

On test stands equipped with a brake force application limiter (optional) the red "Application limiter" lamp will be lit if the brake pedal is depressed too fast. In this case the test will have to be repeated.

The ratio of maximum brake force of the service brake to the weight of the vehicle should not be less than the legally permissable min. brake force!

Never drive a driven axle from the roller set unless both motors are running and the yellow **ready lamp** is lit. This could lead to serious damage to the electrical and mechanical system of the test stand!

Brake Test

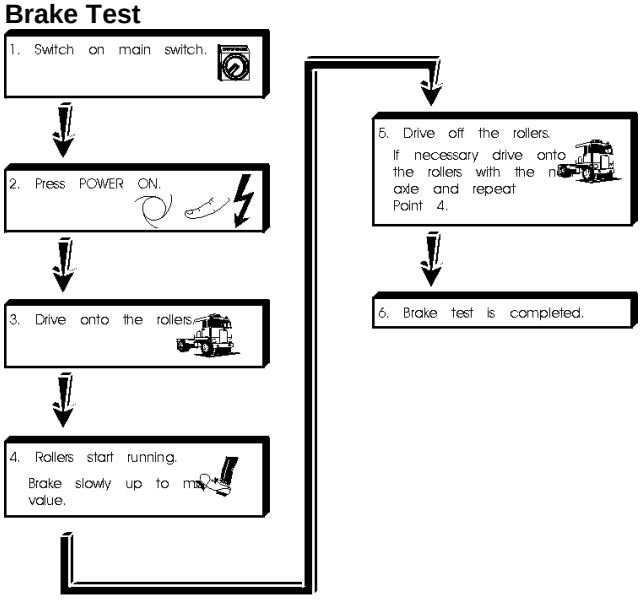
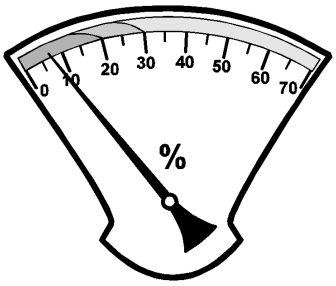

1. Switch on main switch.
2. Press POWER ON.
3. Drive onto the rollers.
4. Rollers start running.
Brake slowly up to max. value.
5. Drive off the rollers.
If necessary drive onto the rollers with the next axle and repeat Point 4.
6. Brake test is completed.

Fig. 3-8: Running a Brake Test

3.6 Imbalance Display (Optional)

- Imbalance display
  The imbalance display will show the difference between the right-hand and left-hand brake force in percentage (%). The imbalance display will be activated when a pre-set total brake force is reached.
  The brake force difference should not exceed the legal permissable value.



- Testing in the large measuring range
  If a vehicle is tested using the large measurement range (measurement range switch-over on the remote control or on the test stand) it can happen that the necessary trigger value to activate the imbalance display is not reached because the attained brake forces were not high enough. In this case, there will be no imbalance display.

3.7 Special Features on Test Stands with MB Mode

Selection of the operating mode
Test stands with MB-Mode are equipped with an operational selector switch making it possible to switch between:

- "Automatic" : the rollers will start up automatically after the switch-on time delay.and
- "Manual" : the rollers are started one after the other manually by using the remote control. Observe the green lamp which indicates in which operational mode the test stand is.

The green lamp will extinguish if the pit safety system is triggered.

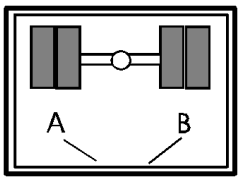
Switching on the unoccupied test stand
The "Automatic" operational mode is started by turning on the main switch while the test stand is **unoccupied**. Use the selector switch to switch to "Manual" operation.

Switching on the occupied test stand
The "Manual" operational mode is started by turning on the main switch while the test stand is **occupied**. The test stand can only be switched to "Automatic" operational mode when it is unoccupied.

Acknowledging malfunctions
Test stands with MB-Mode are also equipped with a malfunction button. If problems occur during operation, the malfunction lamp will light up. Certain problems can be acknowledged by pressing the malfunction button. (see defect codes).

If the trouble occurs while the test stand is occupied, it immediately switches to "Manual" operation.

3.8 Special Points about the Portugal-Mode



Select weight transfer
Test stands with the Portugal-Mode are equipped with a selection switch with which the weight transfer can be selected. (in **unoccupied test stand**) :

Position A: Weight of the axle (for TRK) is measured via the brake tester (internal scale).

Position B: Weight of the axle (for Car) is measured via the shock absorber tester (external scale) and transferred to the brake tester.

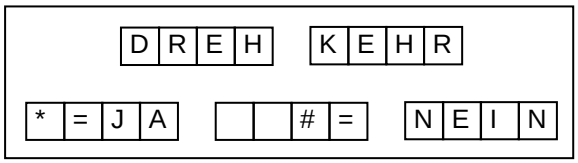
3.9 Special Points about the Sweden Mode

The Pseudo 4 wheel drive measurement can be done using the special rotation direction reverse on test stands with the Sweden mode.

Test Procedure:

1. In **unoccupied test stand** press the key combination **SHIFT + D** on the remote control to activate the rotation direction reverse and/or manual operation.

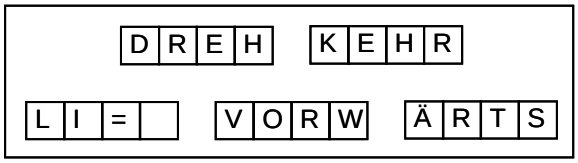
Following message appears on the display:



2. Confirm the rotational direction reverse with the ***-key** on the remote control.

Deactivate the rotational direction reverse again using the **#-key** on the remote control.

3. **Drive onto the test stand**.
Following message appears on the display:

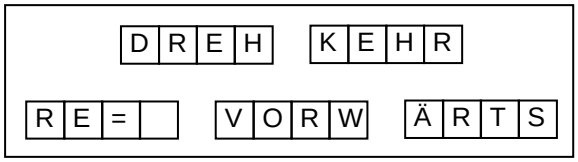


4. Press the **left Motor-On key** of the remote control**.**

Both motors start simultaneously, counter clockwise. The selected side rotates in a forward direction.
Conduct the measurement.

If slip is reached the motors switch off.
If slip is not reached , the motors must be switched off using the Motor Off key on the remote control.

The right side is measured after the left hand side.
Following message appears on the display:



5. Press the **right Motor On key** on the remote control.

Both motors start up simultaneously, counter clockwise. The selected side rotates in the forward direction.
Conduct the measurement.

If slip is reached the motors switch off.
If slip is not reached , the motors must be switched off using the Motor Off key on the remote control.

6. After the motors have switched off the measurement values are shown on the display. Store the measurement value using the **appropriate key combination**. (see the operating manual of the remote control).

After exiting the roller set and storing of the measurement values the rotational direction reverse is immediately deactivated. The test stand is in the Automatic mode again.

3.10 Special Points about the Hongkong Mode

Test stands with the Hongkong mode one side will continue to measure even once the other side has switched off via slip. The other wheel will be blocked at a later point in time due to the pedal force being raised.

Test Procedure
Switch on the test stand and and wait for ready-to-test.

1 Drive onto the rollers.

2 Rollers start up.

3 Brake slowly until one roller side has reached slip.
Either the left or right hand side will switch off.
The respective pointer falls back to zero.

4 Slowly continue to brake until the other roller side has reached slip.
Either the left or right hand side will switch off.
The respective pointer stops and the other pointer shows the first brake value.

Slip is too small:
The roller does not switch off.
Release the brake.
Store the max. value using the corresponding key combination on the remote control.

4 Maintenance, Error Codes

4.1 Maintenance of the Roller Set

The roller set should be inspected and serviced every 200 operating hours or once every 12 months, whichever comes first. The inspection should include a thorough check of the anchoring of the roller set as well as all fasteners and screws. The chain tension must be checked for the first time 14 days after initial commissioning and afterwards inspected on a monthly basis.

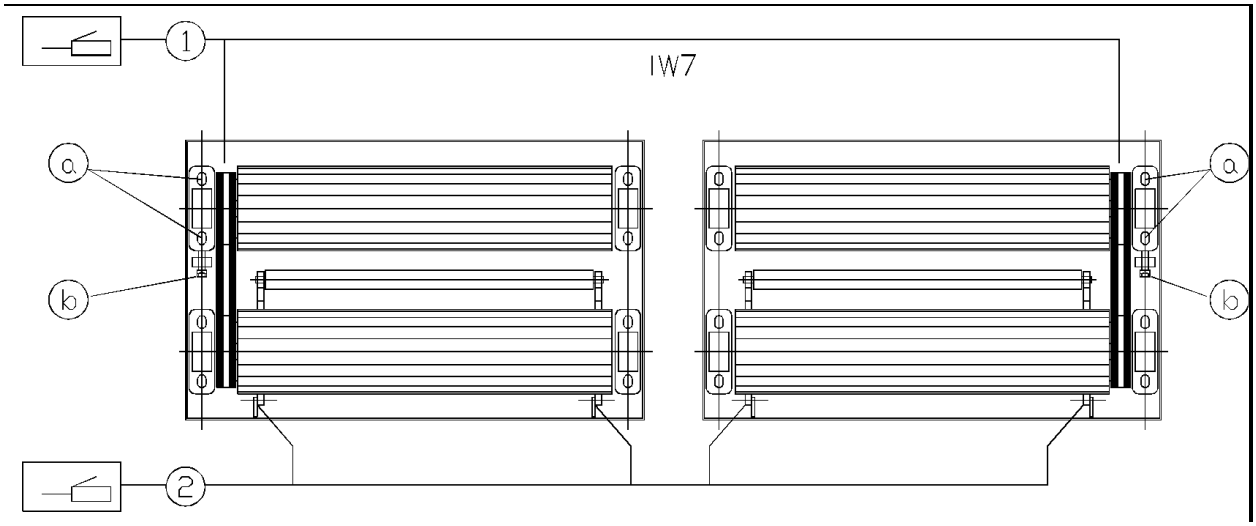


Fig. 4-1: Maintenance points on the roller set

- Remove the lateral cover plates of the roller set. Now grease the chain (1) along its entire length well with a universal type lubricant (turn the rollers manually)
- The chain should have a slack of about 5 mm in either direction. If the chain does not have enough tension, loosen the attachment screws (a). Turn the tension screw (b) until proper tension is achieved. When this is completed re-tighten the attachment screws (a) and check the chain slack again.
- The sensor roller hinges (2) must be regularly greased or oiled every 200 operating hours or at least once a year.

4.2 Description of Error Codes

When problems occur with the operation of the IW4/IW7 WB/WBV (4WD) a "defect code" will appear. This code can be read on the pointer of the small measurement range. All defect codes (except 33) can be acknowledged using the **POWER ON** key or the **'*'** key on the remote control.

E.g. defect code 32 will appear as follows:

3 kN on the left hand display

2 kN on the right-hand display

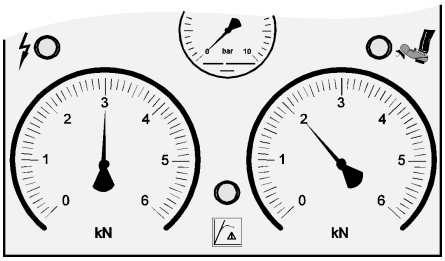


Fig.. 4-2: Analog display of an error code

4.3 General Error Codes

Error Code	Description	Remedy
20 21 22	Right-hand motor protection switch is set to 'Aus'/'OFF' Left-hand motor protection switch is set to 'Aus'/'Off' Right and left-hand protection switch is set to 'Aus'/'Off'	Press right-hand and/or left-hand motor protection switch again. Switch main switch off and then on again and press Power-On button. Contact the MAHA-Service Dept. ATTENTION ! Possible damage to the motors.
32 *)	Left-hand proximity switch is defective or connection to the printed circuit board of the test stand is disturbed	Check proximity switch to make sure switch distance and connections have proper contact. Contact MAHA-Service Dept. ATTENTION ! Exit support is out of order!
34 *)	Right-hand proximity switch is defective or connection to the printed circuit board of the test stand is disturbed	Check proximity switch to make sure switch distance and connections have proper contact ATTENTION ! Exit support is out of order!

*) Error Codes 32 and 34:
Error messages can be acknowledged with the **'Power ON' key. Afterwards the pointers of the analog display got to zero and the test stand is ready for testing again. Pay attention that the exit assistance is no longer activated and that no slip monitoring takes place on the defective side!**

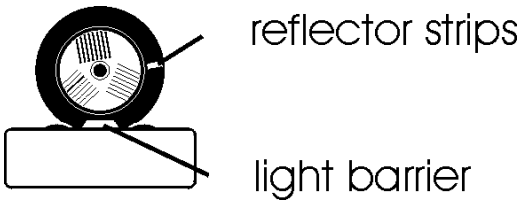
Defect Code	Description	Remedy
33	Both proximity switches are defective or not properly connected to the PCB of the test stand Selector switch **'Driving Direction Reverse'** (optional) is set on position 0. Fuse of phase L2 and/or L3 has blown out. Switch for speed switch over is set to Position 0 (optional)	Check proximity switch to make sure switch distance and connections have proper contact. **ATTENTION !Exit support is out of order! *)** Drive vehicle out of the rollers and set selector switch **'Driving Direction Reverse'** to position '1' or '2' . Switch test stand off and exchange fuses. **ATTENTION !** If the defect occurs a second time do not operate the test stand any longer and notify the **customer service dept. immediately!**
40	Zero point adjustment is defective	Re-adjust zero. While the Power-On button is pressed the defective zero point can be re-adjusted. **ATTENTION!** Testing can be resumed after pressing the Power-On key but the attained measurement values will not be exact based on the zero point deviation
41 42	Only the left-hand sensor roller is pressed down Only the right-hand sensor roller is pressed down	If this defect occurs after the test stand has been switched on : it is highly likely that a sensor roller switch is defective.. If this defect occurs when a vehicle drives onto the rollers: it is possible that the vehicle is not positioned properly on the rollers and only one sensor roller is pressed. Re-position the vehicle and its axles and press the Power-On key or the * key on the remote control. **ATTENTION!** Use **extreme caution** when doing this! Customer service should be notified immediately when **sensor roller defects** occur**!**

4.4 Additional Defect Codes on 4-Wheel Drive Test Stands

Slow blinking of the malfunction lamp: The program detects no reflector strips on the left-hand side of the wheel.

Rapid blinking of the malfunction lamp: The program detects no reflector strips on the right-hand side of the wheel.

Rapid/slow blinking of the malfunction lamp: The program detects no reflector strips on either side of the wheel.



The error messages will also appear on the analogue display and on the display.

Defect code	Description	Remedy
43	Moreg defective (general)	Notify the service dept!
44	There is no signal from the left-hand light barrier	Attach reflector strips or position them correctly. It is possible that the light barrier is defective.
45	No signal from the right-hand light barrier	In addition to the defect code the red defect lamp is blinking:
46	No signal from either light barrier	slowly ⇒ left fast ⇒ right fast-slow ⇒ both

4.5 Installation and Dismantling of the Test Stand

The installation or modification of the roller set should only be carried out by the manufacturer's trained authorized personnel or other qualified technicians to avoid any problems with adjustments or settings. (This applies in particular to installed weighing systems.)

Operational malfunctions caused by unqualified installation or alteration work done on the test stand are not covered by the warranty. This regulation applies to the normal warranty period also.

Konformitätserklärung
Declaration of Conformity
Nr. 206305DG

Hiermit erklärt **MAHA Maschinenbau Haldenwang GmbH & Co. KG.** als Hersteller, in alleiniger Verantwortung, dass nachstehend bezeichnete Maschine in Konzeption und Bauart den grundlegenden Sicherheits- und Gesundheitsanforderungen den hier genannten EG-Richtlinien entspricht.

Bei Änderungen an der Maschine, die nicht mit uns abgestimmt und genehmigt wurde, verliert diese Erklärung ihre Gültigkeit.

Herewith **MAHA Maschinenbau Haldenwang GmbH & Co. KG.** declares as a manufacturer its sole responsibility to ensure that the equipment named hereafter meets the safety and health regulations both in design and construction required by the EC Guidelines stated below.

This declaration becomes invalid if any change is made to the equipment that was not discussed and approved by MAHA beforehand.

Bezeichnung

IW 4 WB / WBV

Maschinentyp

Rollen-Bremsprüfstand
bis 13,0 t Achslast (optional bis 15,0 t Achslast)
Antriebsleistung 2 x 5,5 k W; 2 x 7,5 kW; 2 x 9 kW; 2 x 11 kW

Model:

IW 4 WB / WBV

Type of equipment:

Roller Brake Tester
up to 3.5 t axle load
Motor drive power 2 x 5.5 k W; 2 x 7.5 kW; 2 x 9 kW; 2 x 11 kW

EG-Richtlinien:

- 98/37/EG für Maschinen
- 89/336/EG für Elektromagnetische Verträglichkeit
- 73/23/EG für Niederspannung

DIN EN-Normen:

- EN 292 Teil 1 und 2, EN 294, EN 349, EN 418
- EN 60204 Teil 1
- EN 50081 Teil 1, EN 50082 Teil 2

Technische Dokumentation:

- Entwicklungs- und Konstruktionsunterlagen
- Gefahren- und Risikoanalyse
- Handbuch des Qualitätsmanagements
- Zertifikat nach DIN EN ISO 9001
- Sicherheitsgerechte Bedienungsanleitung
- Montage- und Installationsanleitung

EC Guidelines:

- 98/37/EEC for machines
- 89/336/EEC for electro-magnetic compability
- 73/23/EEC for low voltage

EN Standards:

- EN 292 Part 1 and 2, EN 294, EN 349, EN 418
- EN 60204 Part 1
- EN 50081 Part 1, EN 50082 Part 2

Technical Documentation:

- Design and construction documents
- Danger and risk analysis
- Quality Management Handbook
- Certificate in accordance with EN ISO 9001
- Operating manual based on established safety regulations
- Assembly and installation instructions

Haldenwang, den 03.08.2005

Technischer Leiter / Technical Director

MAHA Maschinenbau Haldenwang GmbH & Co. KG. • Hoyen 20 • 87490 Haldenwang • Germany
Fon +49 (0) 8374 585-0 • Fax +49 (0) 8374 585-499 • Internet www.maha.de • E-Mail maha@maha.de

Konformitätserklärung
Declaration of Conformity
Nr. 208305DG

Hiermit erklärt **MAHA Maschinenbau Haldenwang GmbH & Co. KG.** als Hersteller, in alleiniger Verantwortung, dass nachstehend bezeichnete Maschine in Konzeption und Bauart den grundlegenden Sicherheits- und Gesundheitsanforderungen den hier genannten EG-Richtlinien entspricht.

Bei Änderungen an der Maschine, die nicht mit uns abgestimmt und genehmigt wurde, verliert diese Erklärung ihre Gültigkeit.

Herewith **MAHA Maschinenbau Haldenwang GmbH & Co. KG.** declares as a manufacturer its sole responsibility to ensure that the equipment named hereafter meets the safety and health regulations both in design and construction required by the EC Guidelines stated below.

This declaration becomes invalid if any change is made to the equipment that was not discussed and approved by MAHA beforehand.

Bezeichnung

IW 7 WB / WBV (Allrad)

Maschinentyp

Rollen-Bremsprüfstand
bis 18,0t Achslast (optional bis 20,0 t)
Antriebsleistung 2 x 7,5 kW; 2 x 11 kW; 2 x 16 kW
Prüfgeschwindigkeit 3 km/h und 6 km/h

Model:

IW 7 WB / WBV (4WD)

Type of equipment:

Roller Brake Tester
up to 18.0t axle load (optional up to 20.0 t)
Motor drive power: 2 x 7.5 kW; 2 x 11 kW; 2 x 16 kW
Test speed 3 km/h and 6 km/h

EG-Richtlinien:

- 98/37/EG für Maschinen
- 89/336/EG für Elektromagnetische Verträglichkeit
- 73/23/EG für Niederspannung

DIN EN-Normen:

- EN 292 Teil 1 und 2, EN 294, EN 349, EN 418
- EN 60204 Teil 1
- EN 50081 Teil 1, EN 50082 Teil 2

Technische Dokumentation:

- Entwicklungs- und Konstruktionsunterlagen
- Gefahren- und Risikoanalyse
- Handbuch des Qualitätsmanagements
- Zertifikat nach DIN EN ISO 9001
- Sicherheitsgerechte Bedienungsanleitung
- Montage- und Installationsanleitung

EC Guidelines:

- 98/37/EEC for machines
- 89/336/EEC for electro-magnetic compability
- 73/23/EEC for low voltage

EN Standards:

- EN 292 Part 1 and 2, EN 294, EN 349, EN 418
- EN 60204 Part 1
- EN 50081 Part 1, EN 50082 Part 2

Technical Documentation:

- Design and construction documents
- Danger and risk analysis
- Quality Management Handbook
- Certificate in accordance with EN ISO 9001
- Operating manual based on established safety regulations
- Assembly and installation instructions

Haldenwang, den 03.08.2005

ppa.

Technischer Leiter / Technical Director

MAHA Maschinenbau Haldenwang GmbH & Co. KG. • Hoyen 20 • 87490 Haldenwang • Germany
Fon +49 (0) 8374 585-0 • Fax +49 (0) 8374 585-499 • Internet www.maha.de • E-Mail maha@maha.de

Qualitätsnachweis
für Montage- und Servicearbeiten

Bitte beachten	Diesem Qualitätsnachweis liegen die Montage-, Kalibrier- und Serviceanleitungen sowie die betreffenden Protokolle für die einzelnen Produkte gemäß den Herstellerangaben bzw. den jeweils gültigen Richtlinien zugrunde.	**Bitte beachten**

	Kundenanschrift	
Firma		
Ansprechpartner		
Straße		
PLZ, Ort		
Telefon / Fax		
Markenvertretung		**Firmenstempel**

	Installation, Inbetriebnahme & Nachfolgeservice		
Produkte	Typ:	Seriennummer:	Raum für weitere Geräte Seite 2
	☐ Liste fortgeführt auf Seite 2		

Bestätigung	☐ Einweisung durchgeführt ☐ Bedienungsanleitung erhalten (Die CE-Konformitätserklärung befindet sich auf der letzten Seite) ☐ Wir bestätigen hiermit die ordnungsgemäße Übergabe und die ordentliche Ausführung der Servicearbeiten für die aufgeführten Geräte.		
Ort, Datum			**Ort, Datum**
Unterschrift Kunde mit Firmenstempel			**Unterschrift Servicetechniker**

Raum für Bemerkungen		**Raum für Bemerkungen**
Bitte beachten	Die Firma MAHA als Hersteller der Produkte übernimmt Garantie- oder Produkthaftungsansprüche nur bei ordentlich ausgefülltem Protokoll. Das Protokoll ist innerhalb 2 Wochen nach Inbetriebnahme der Geräte an den Hersteller zu schicken.	**Bitte beachten**

MAHA Maschinenbau Haldenwang GmbH & Co. KG. ◆ Hoyen 20 ◆ 87490 Haldenwang ◆ Germany
Tel. +49 (0) 8374 585-0 ◆ Fax +49 (0) 8374 585-499 ◆ Internet: www.maha.de ◆ E-mail: maha@maha.de

	Installation, Inbetriebnahme & Nachfolgeservice	
Produkte	Typ:	Seriennummer: